Reducing postharvest losses

- Postharvest technology techniques by:
- Temperature management procedures
- Control of relative humidity (avoid water loss)
- Atmospheric composition (Controlled Atmosphere storage, Modified atmosphere packaging)
- Chemical treatments (control of physiological disorders)
- Removal of ethylene and other volatiles when needed
- Supplements to temperature control (curing, cleaning, sorting, waxing, heat treatments, ethylene treatments)
- Biotechnology approach?

Temperature management during the PH life

1. Cooling of horticultural commodities

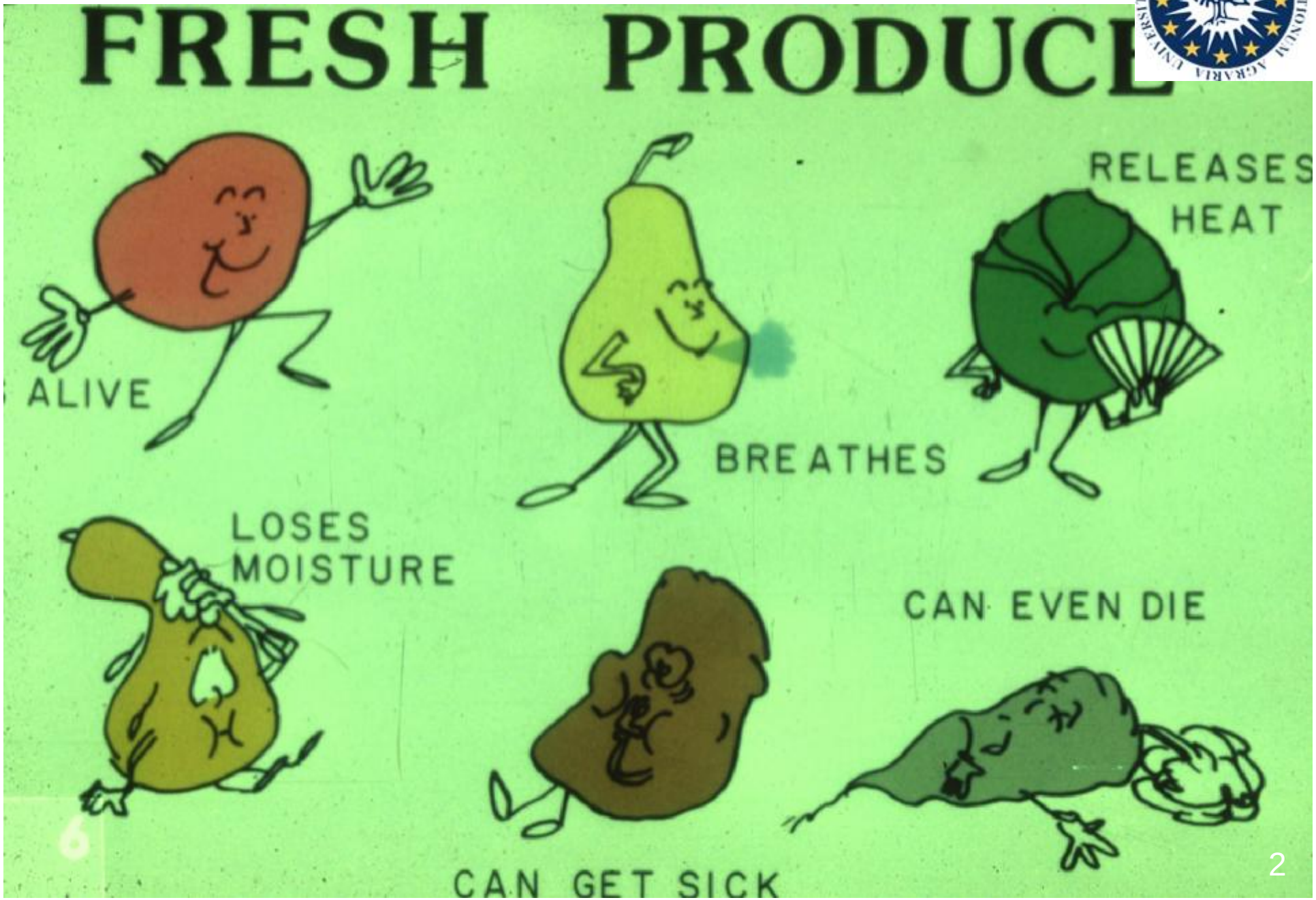
Cooling terms
Cooling methods
Factors affecting cooling efficiency

1. Cooling of horticultural commodities

Cooling terms

The need for cooling

The horticultural commodities are living organisms



Respiration

the process by which food reserves are converted to energy

$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + 675$ cal

Vital heat

Product temperature the major determinent of respiration rate

Effect of temperature on deterioration rate of a non-chilling sensitivity commodity

$$\frac{\text{Relative velocity of deterioration at °C +10°}}{\text{Relative velocity of deterioration °C}}$$

Effects of temperature on deterioration rate of nonchilling sensitive commodity

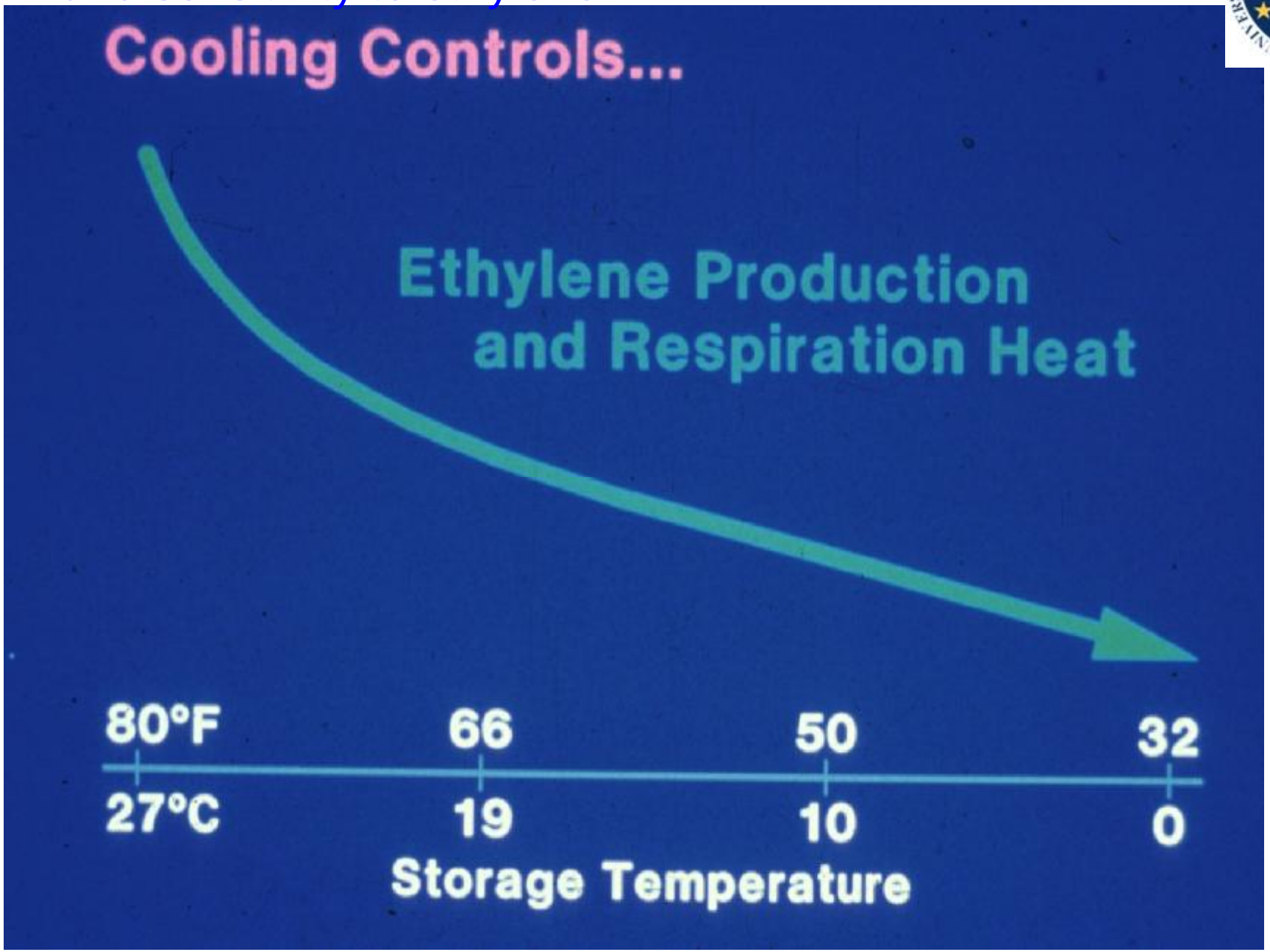
Temperature ÆC	Assumed Q10	Relative velocity of deterion	Relative shelhlife	Loss per day (%)
0		1	100	1
10	3	3	33	3
20	2.5	7.5	13	8
30	2	15	7	14
40	1.5	22.5	4	25

$$Q10 = \frac{\text{Rate of deterioration at T +10°C}}{\text{Rate of deterioration at T °C}}$$

Best temperature (F°) to maintain quality and maximizing postharvest life

Cooling removes field heat

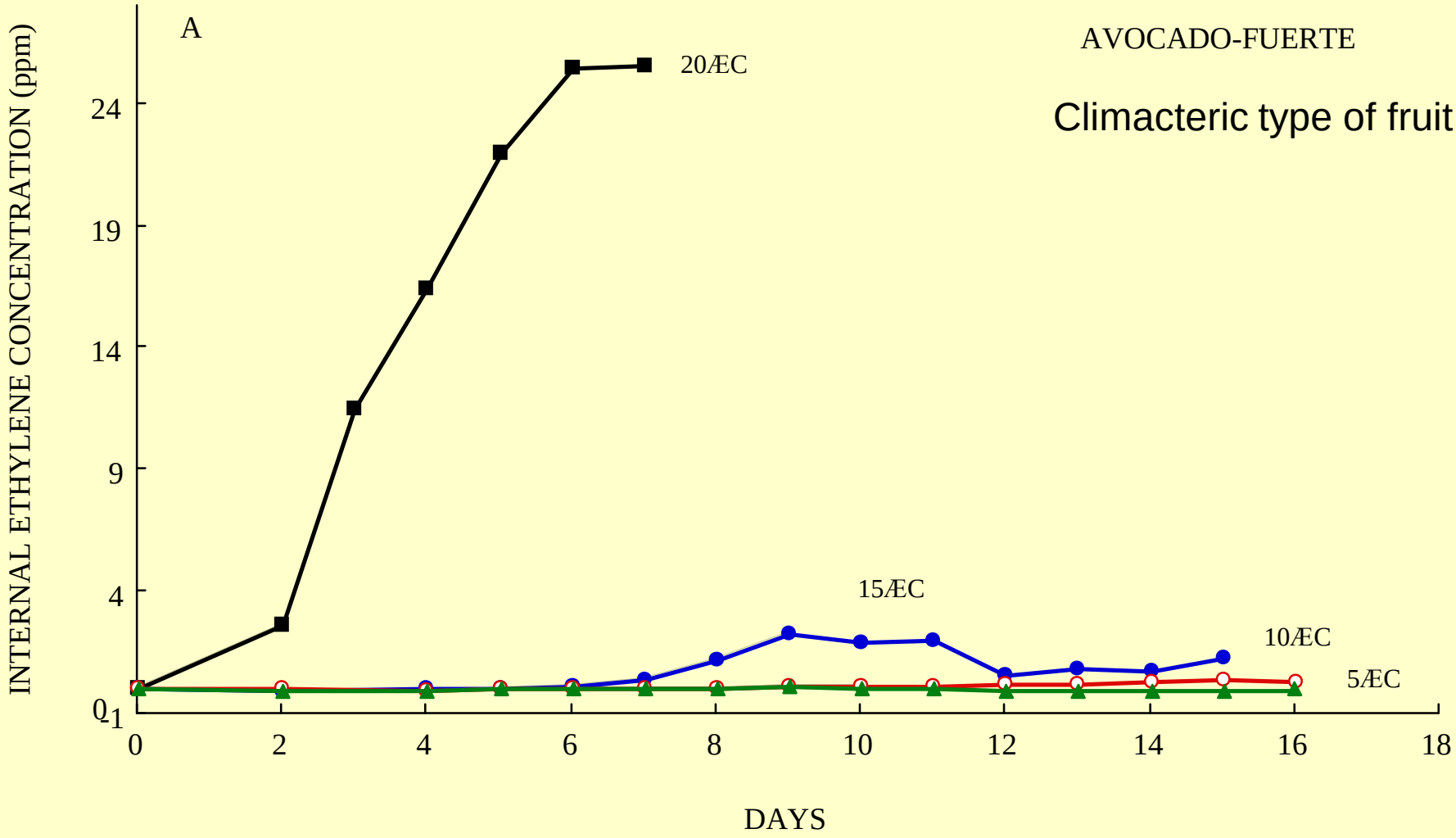
Temperature affects both rate of ethylene production and sensitivity to ethylene

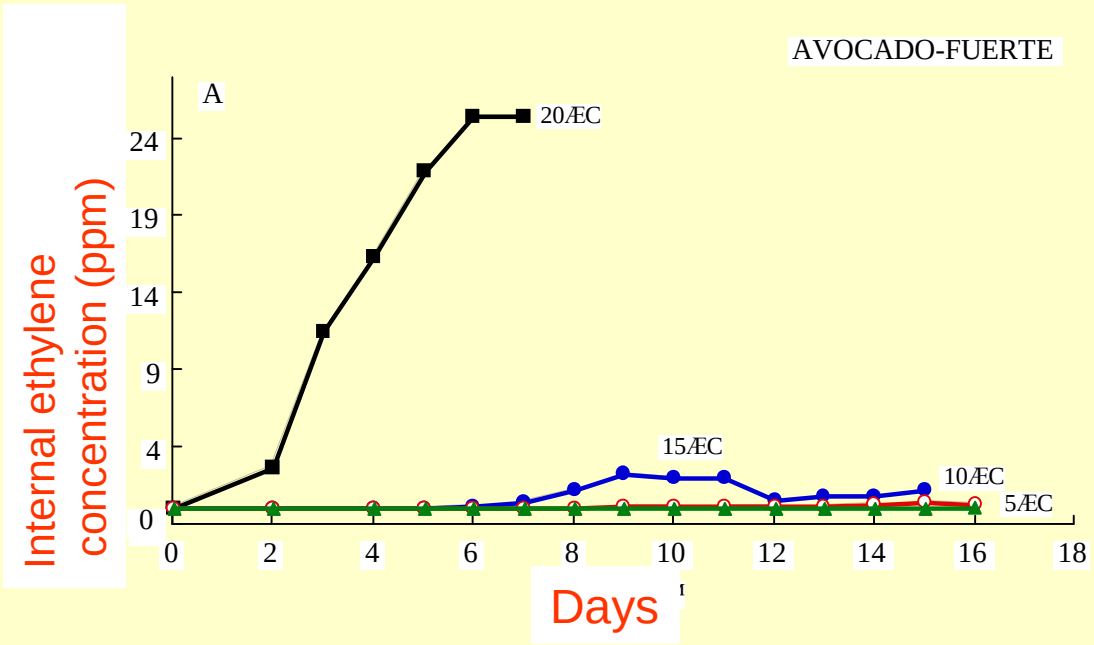


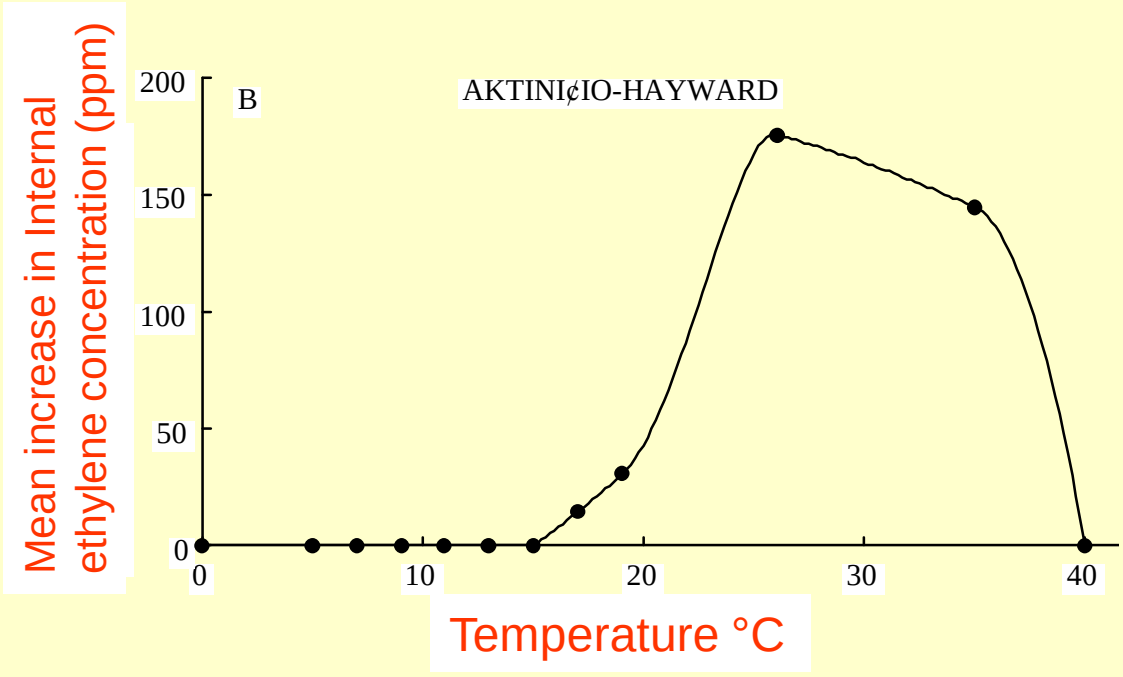
Respiration Rates of Fruits & Vegetables

mg CO_2/kg-hr at 5°C	- Commodities -
< 5	Nuts
5 - 10	Apple, grape, citrus, onion, potato
10 - 20	Apricot, cherry, peach, nectarine, pear, plum, fig, cabbage, carrot, lettuce, pepper, tomato
20 - 40	Strawberry, blackberry, raspberry, cauliflower, lima bean
40 - 60	Artichoke, snap bean, brussel sprouts
> 60	Asparagus, broccoli, mushroom, pea, spinach, sweet corn

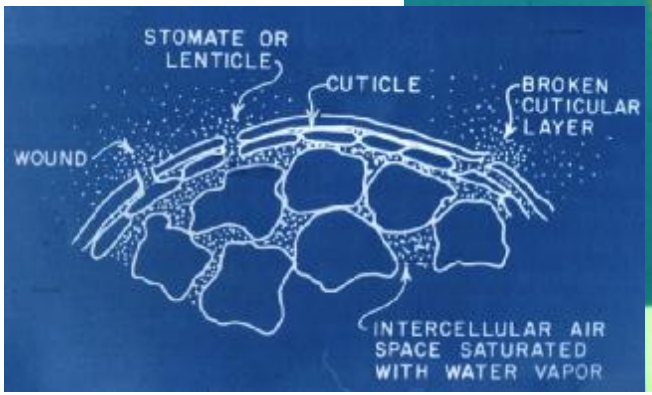
Nonclimacteric


A
AVOCADO-FUERTE
Climacteric type of fruit
20ÆC
15ÆC
10ÆC
5ÆC
INTERNAL ETHYLENE CONCENTRATION (ppm)
24
19
14
9
4
0,1
0
2
4
6
8
10
12
14
16
18
DAYS

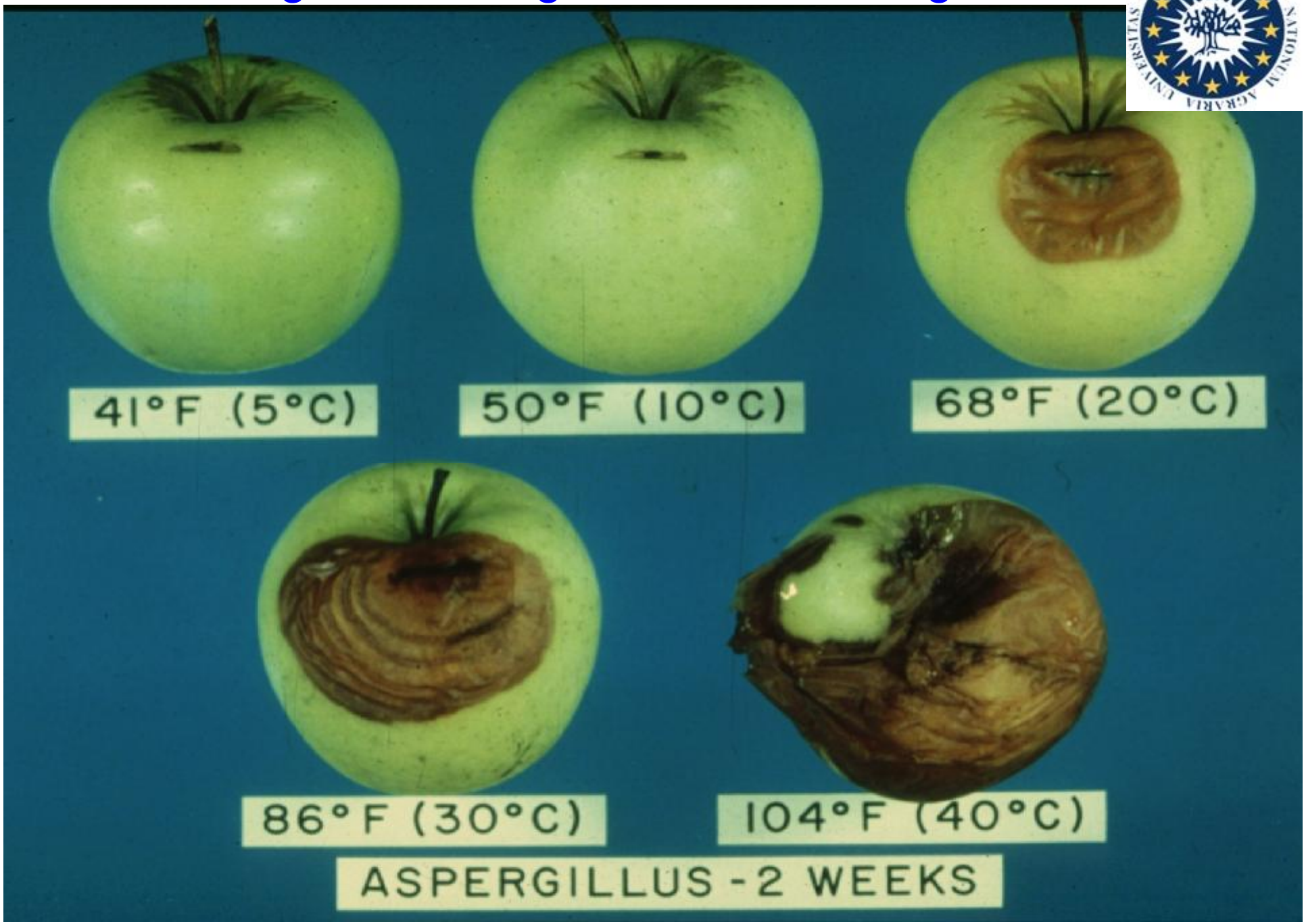

AVOCADO-FUERTE
A
20ÆC
15ÆC
10ÆC
5ÆC
Internal ethylene concentration (ppm)
0
4
9
14
19
24
0
2
4
6
8
10
12
14
16
18
Days


B
AKTINI¢IO-HAYWARD
Mean increase in Internal ethylene concentration (ppm)
0
50
100
150
200
0
10
20
30
40
Temperature °C

Cooling reduces the rate of moisture loss

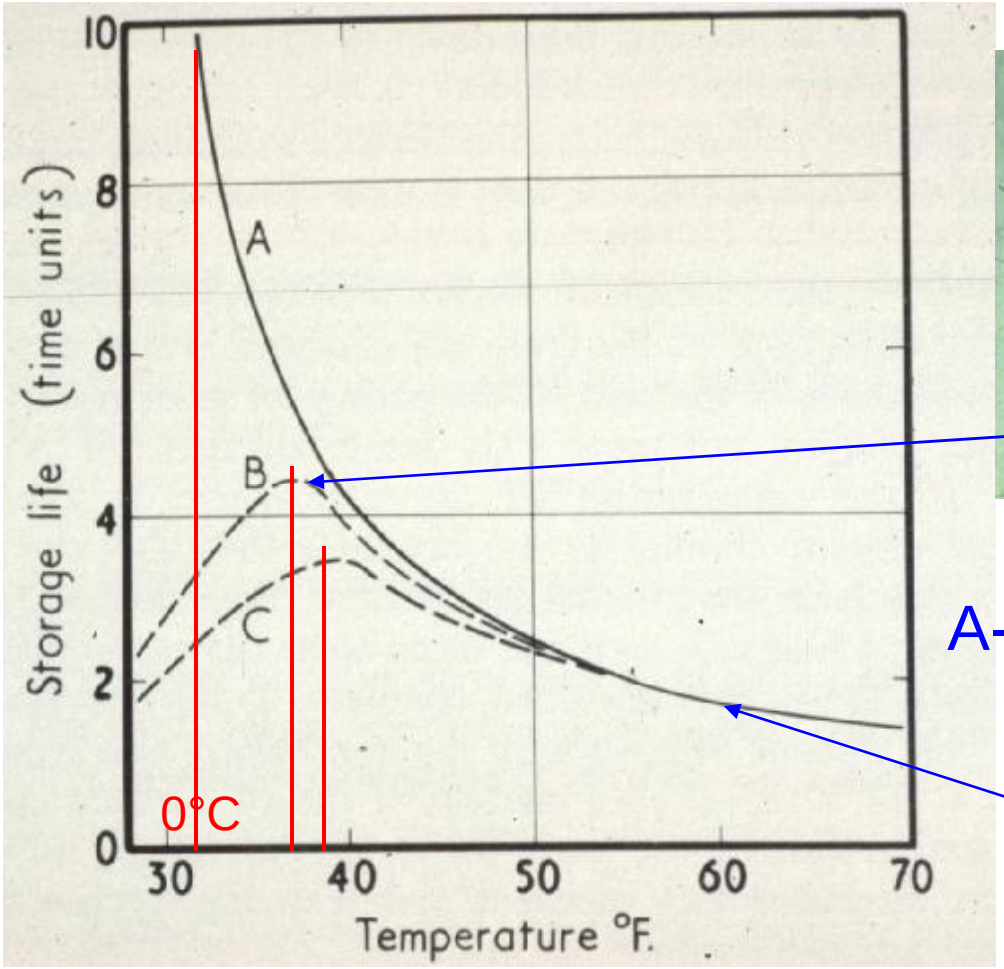


Cooling limits the growth of microorganisms

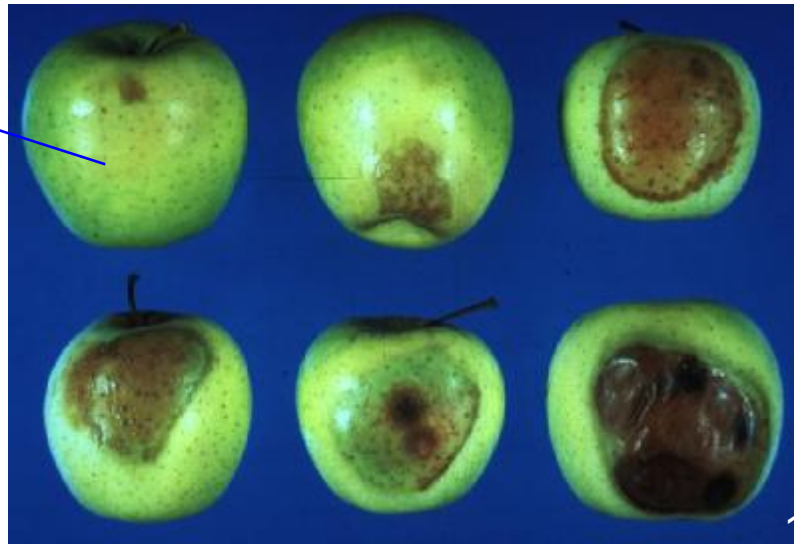


Temperature affects the severity of product response to injuries (ethylene production, water loss, entry of microorganisms)

Cooling of horticultural products



A-Non chilling sensitive products




TOO HIGH
LOWEST SAFE = JUST RIGHT
TOO LOW
INCREASED RATE OF -
DETERIORATION
MAXIMUM SHELF-LIFE
CHILLING INJURY

Sun scald

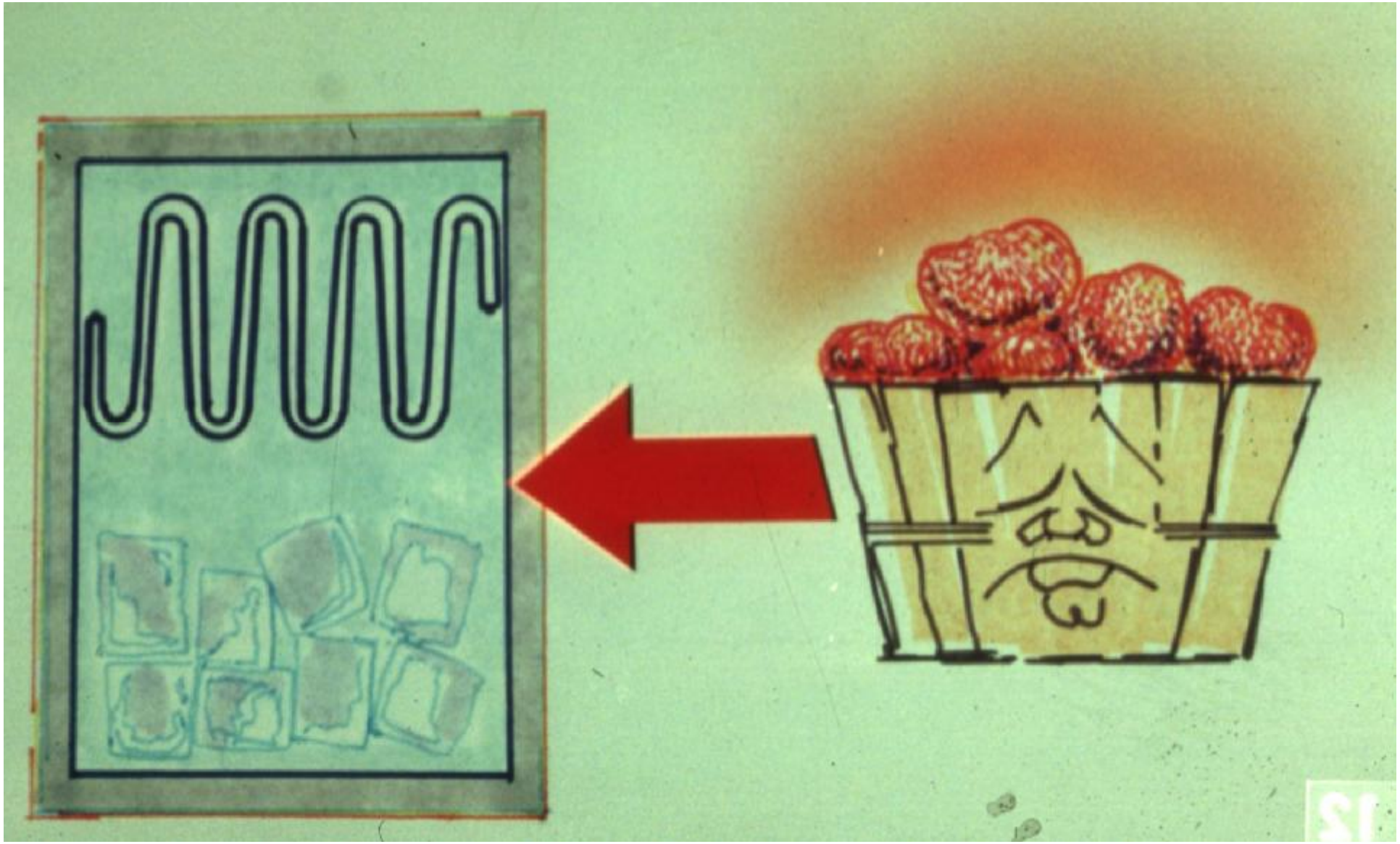
Speed of cooling

Factors affecting cooling

Cooling and storage as separate operations

Heat transfer

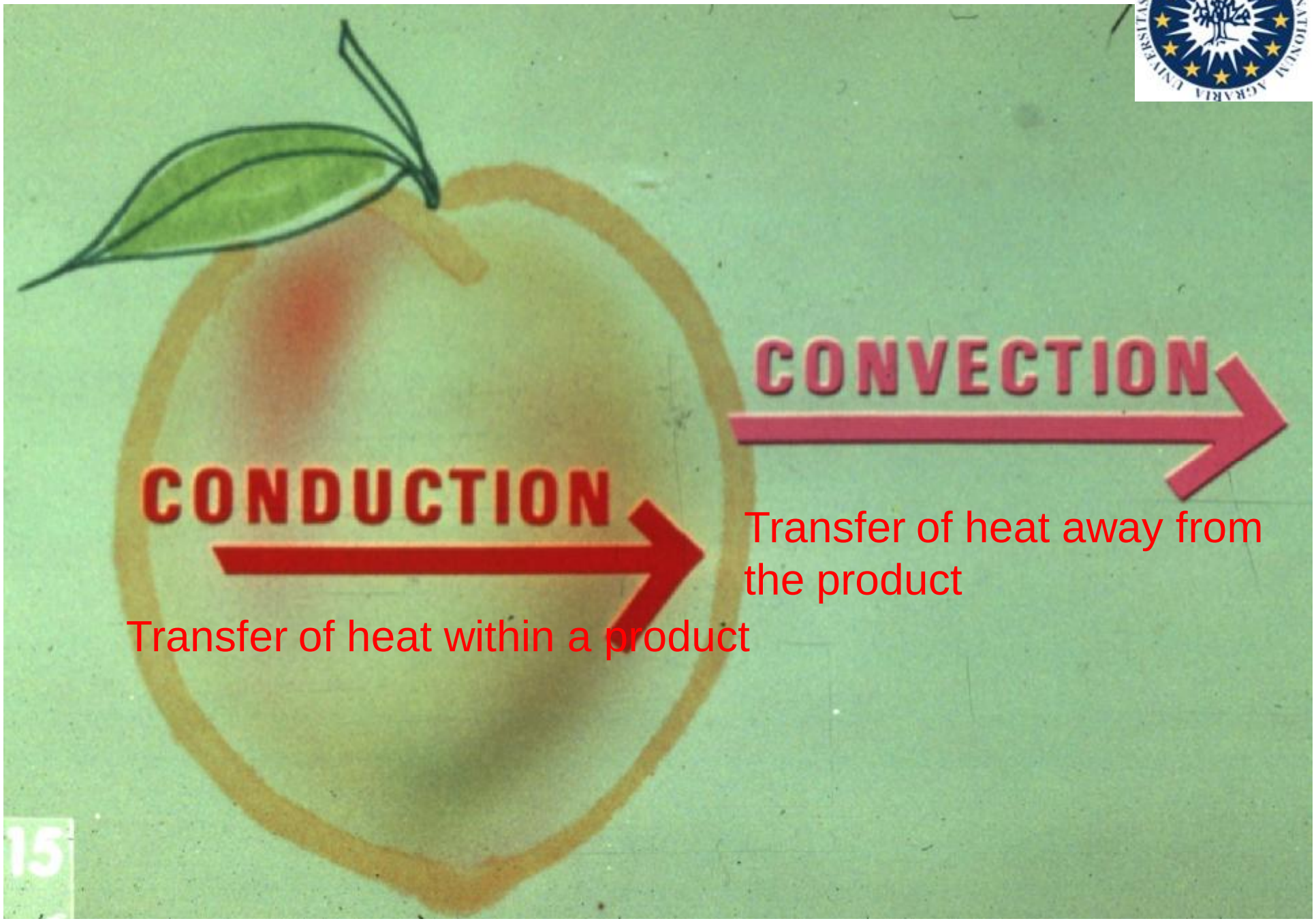
Cooling -- transfere of heat from the produce to the refrigeration



Heat being absorbed by the cooling medium

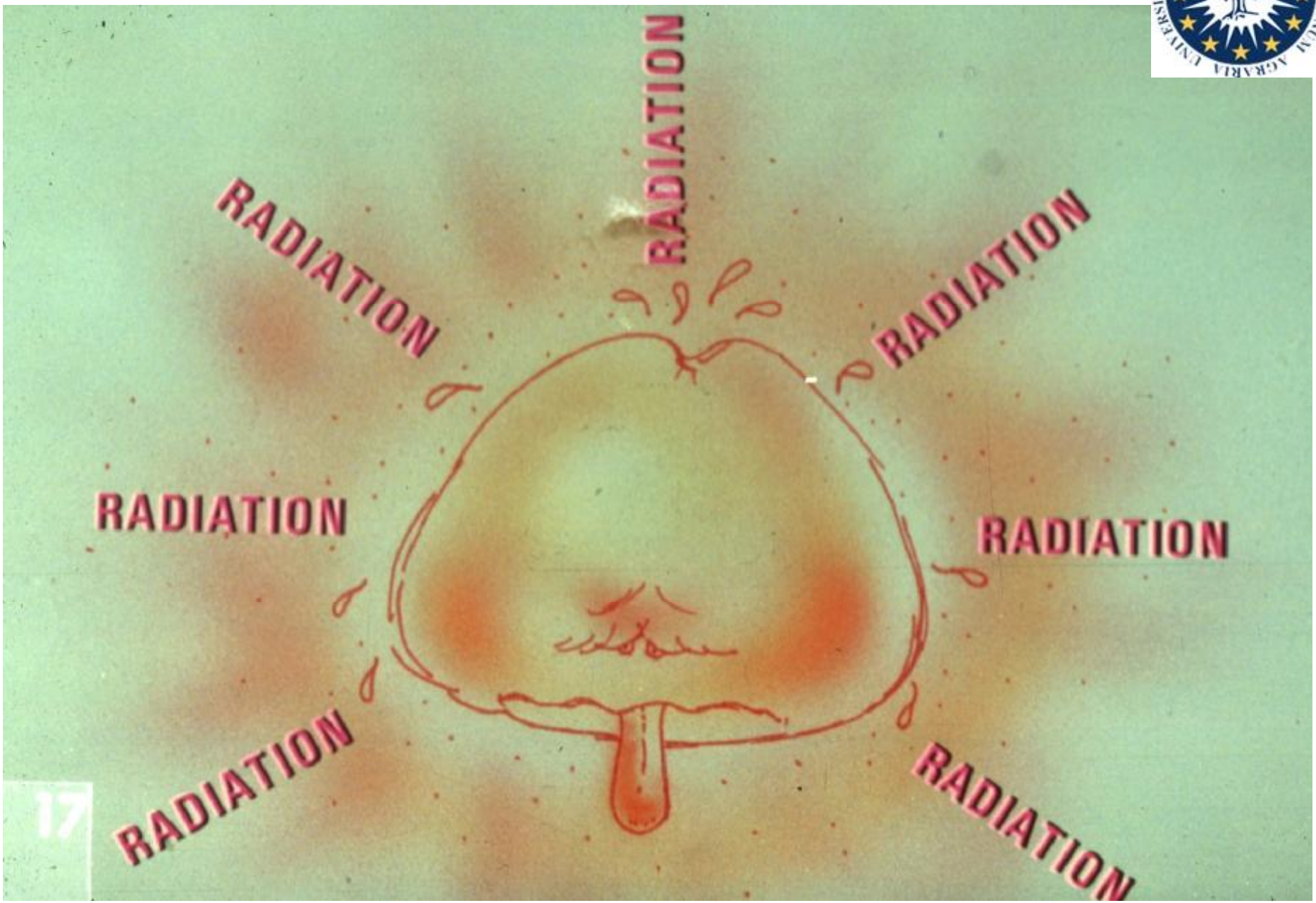
Heat transfer

Conduction
Convection
Radiation
Evaporation


CONVECTION
CONDUCTION
Transfer of heat away from the product
Transfer of heat within a product

Heat transfer by evaporation of water

Cooling of horticultural products



1. Cooling of horticultural commoditis

COOLING METHODS

A. Room cooling

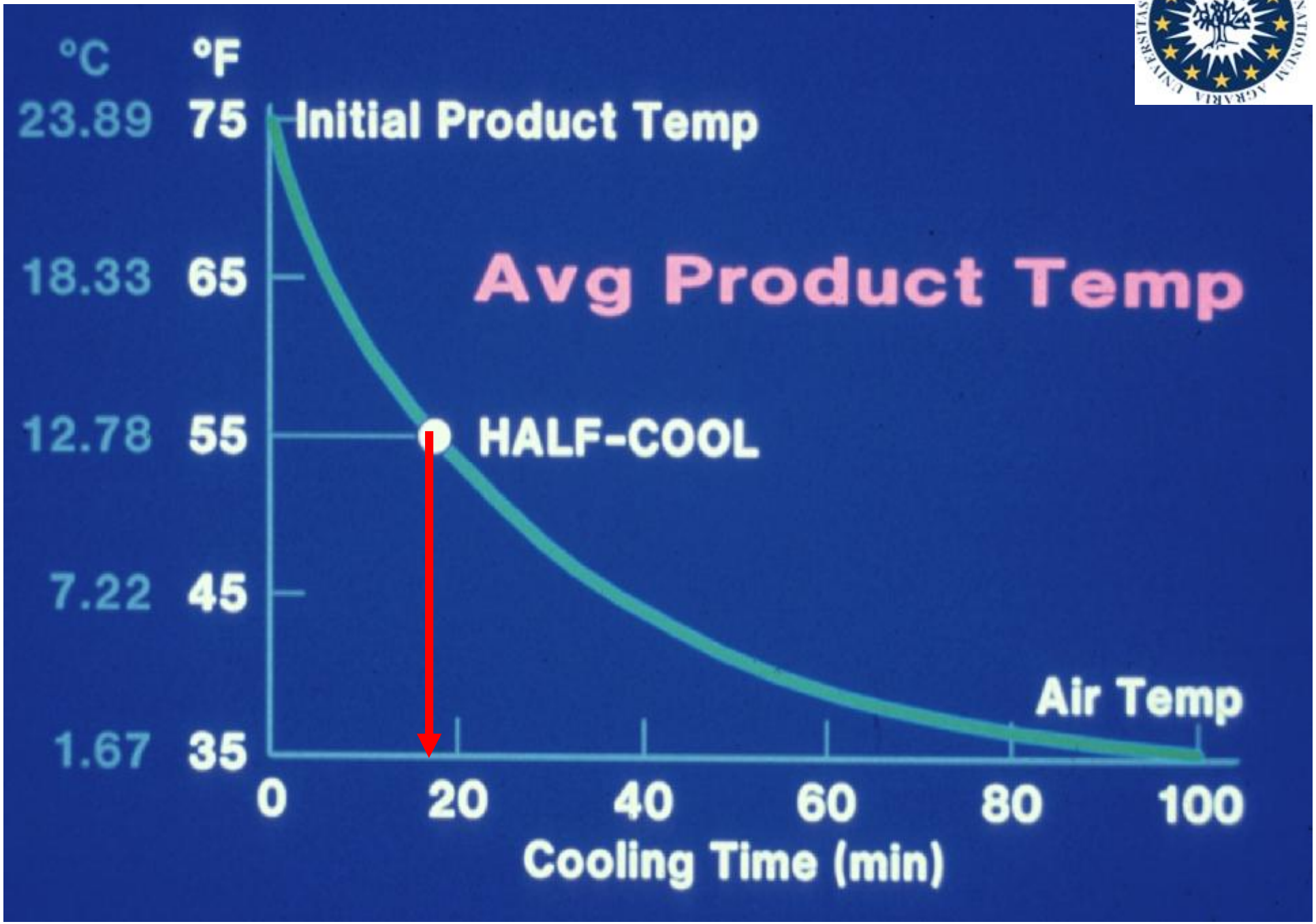
B. Forced-air-cooling

C. Hydrocooling

D. Package-icing

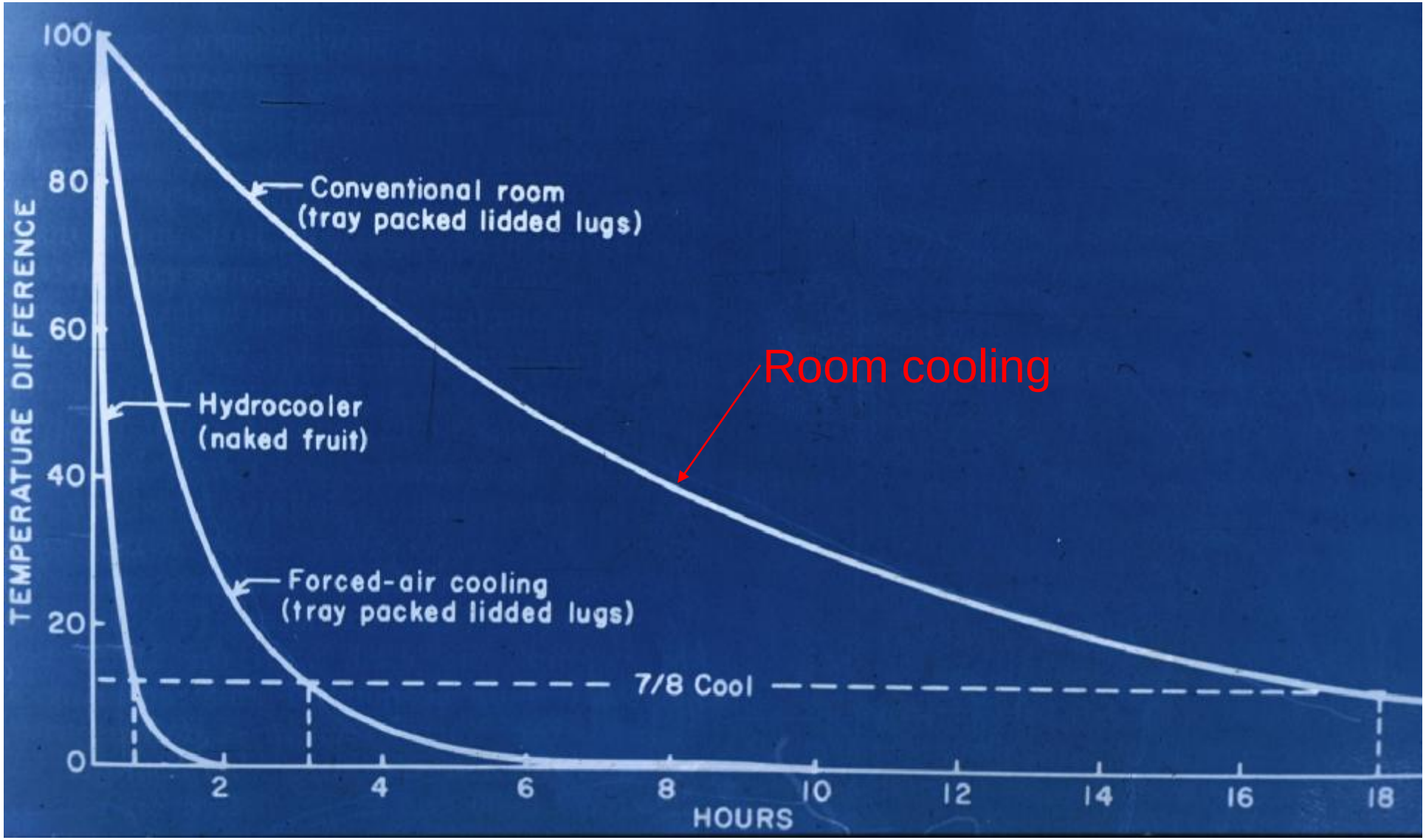
E. Vacuum cooling

Compare cooling methods

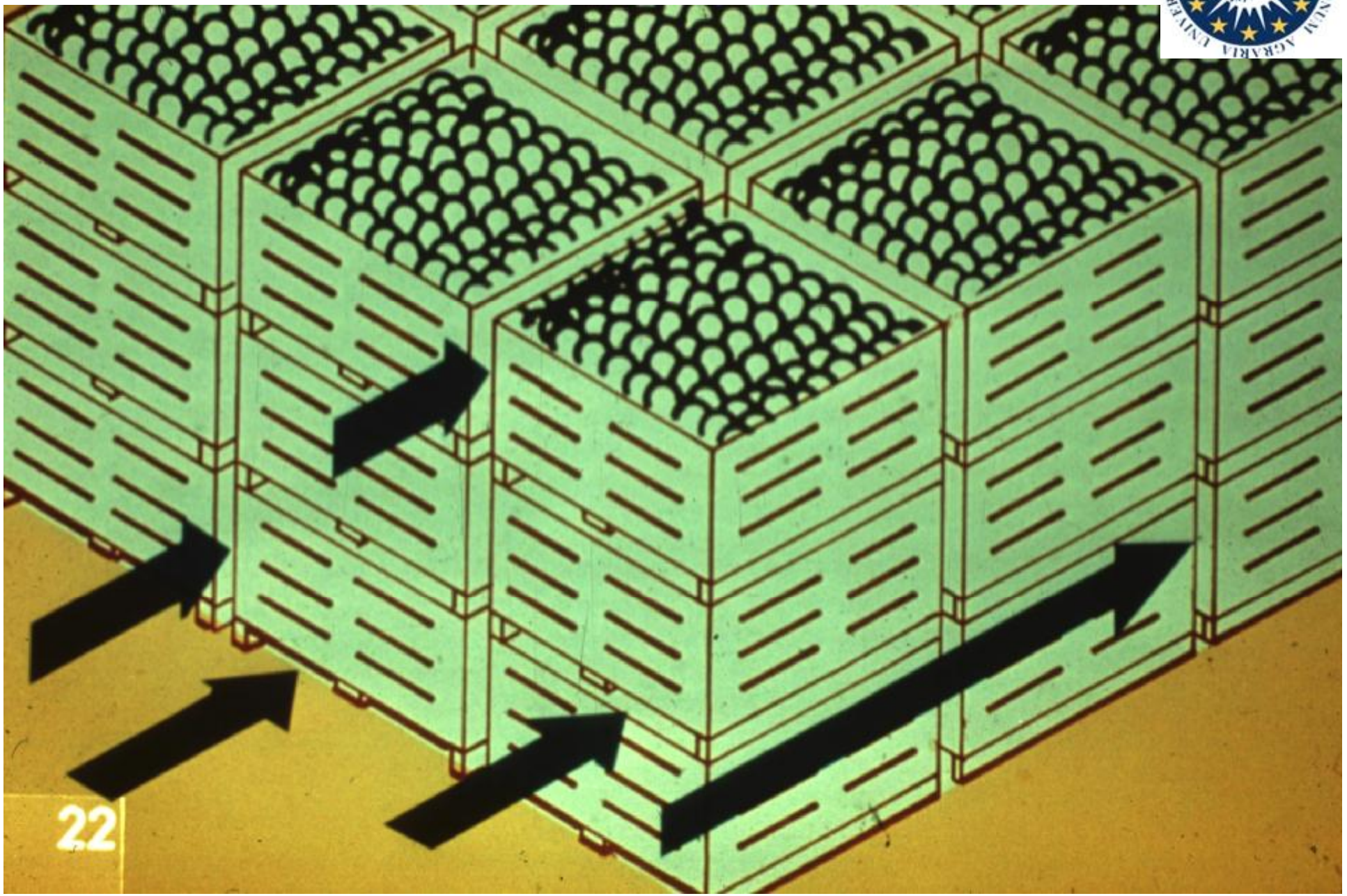


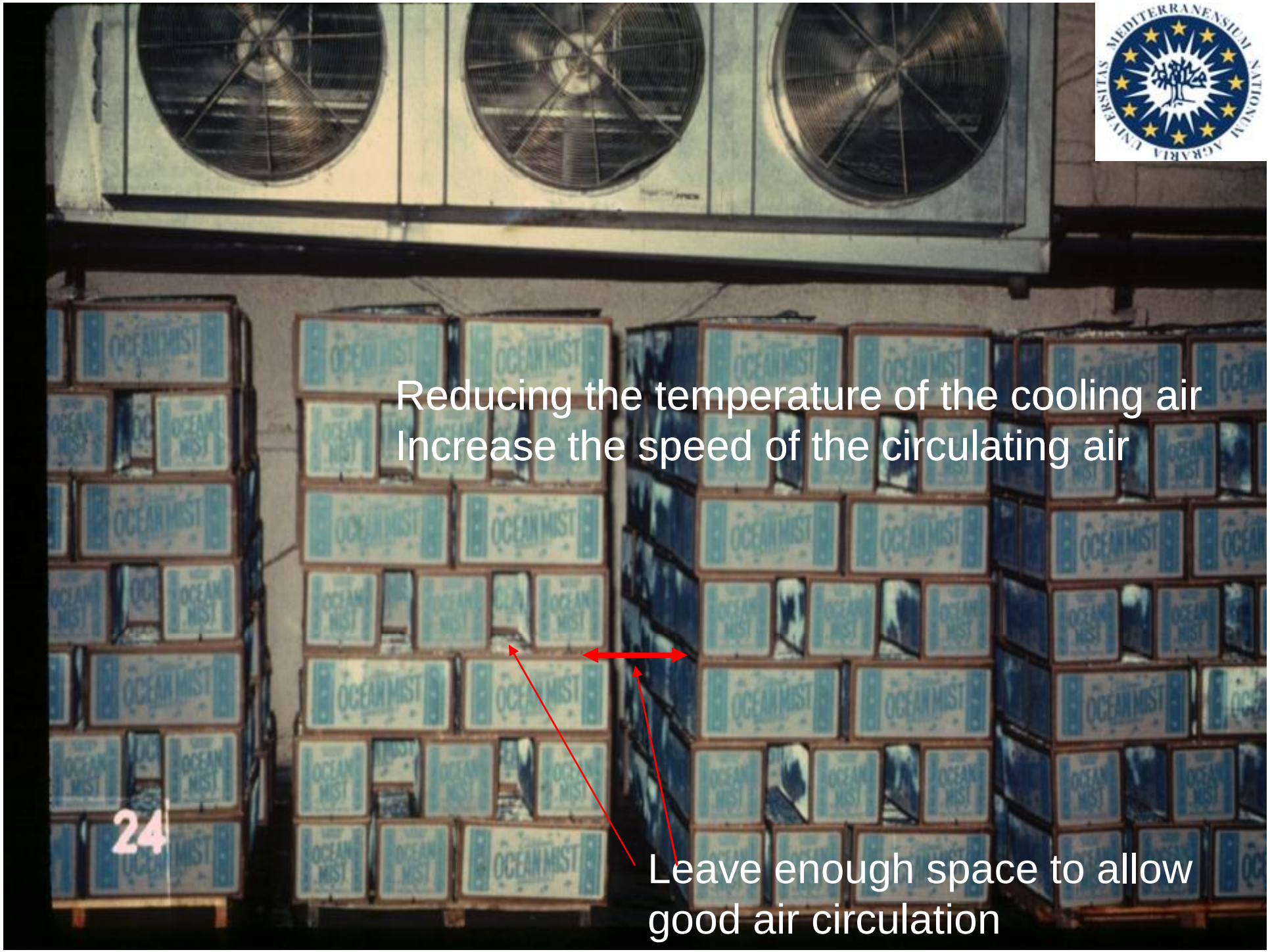

Room Cooling
21

Half cooling time



Cold air circulating around stacked containers of products

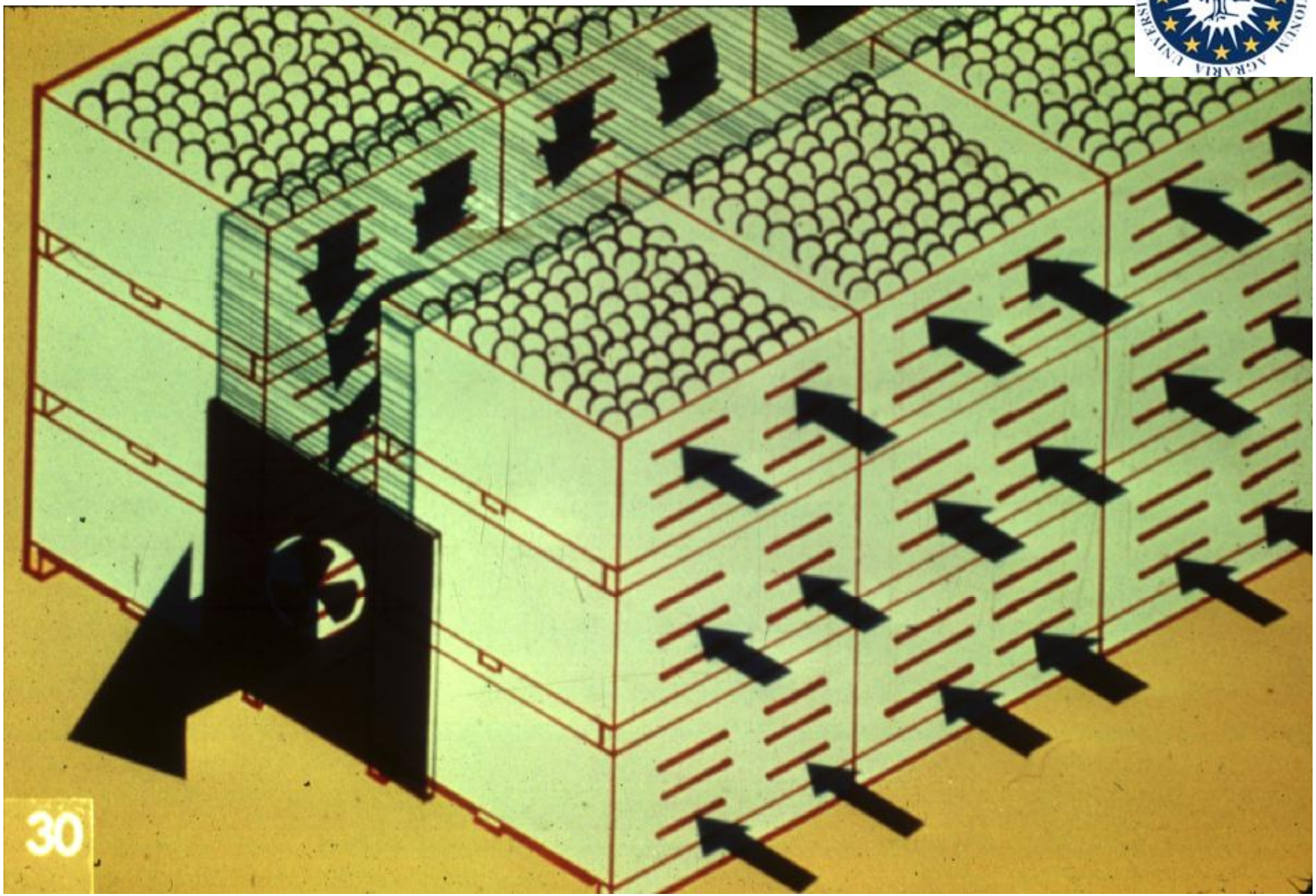



Reducing the temperature of the cooling air
Increase the speed of the circulating air
Leave enough space to allow good air circulation
24

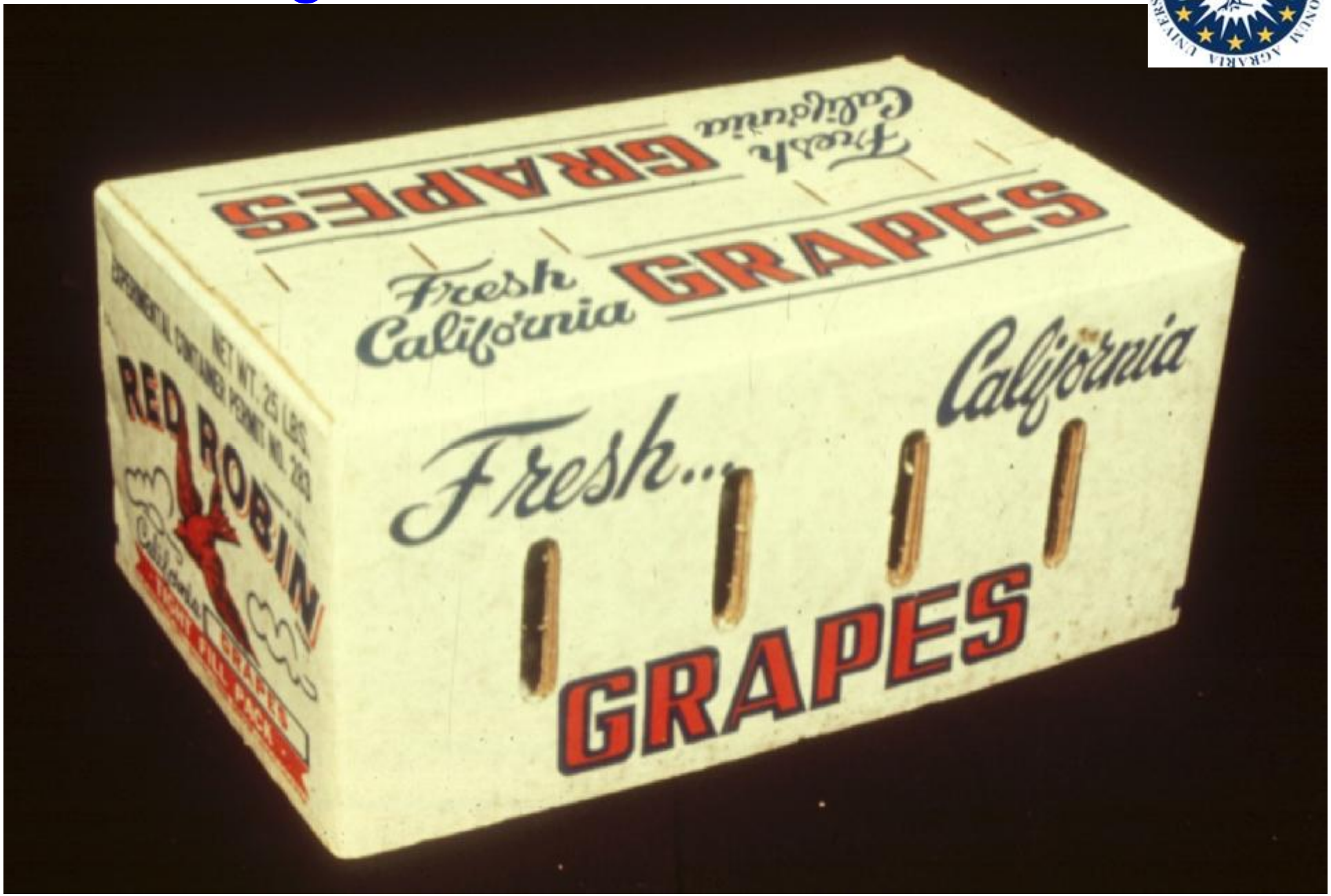
B. Forced-air-cooling

The cooling air is pulled or pushed through the product

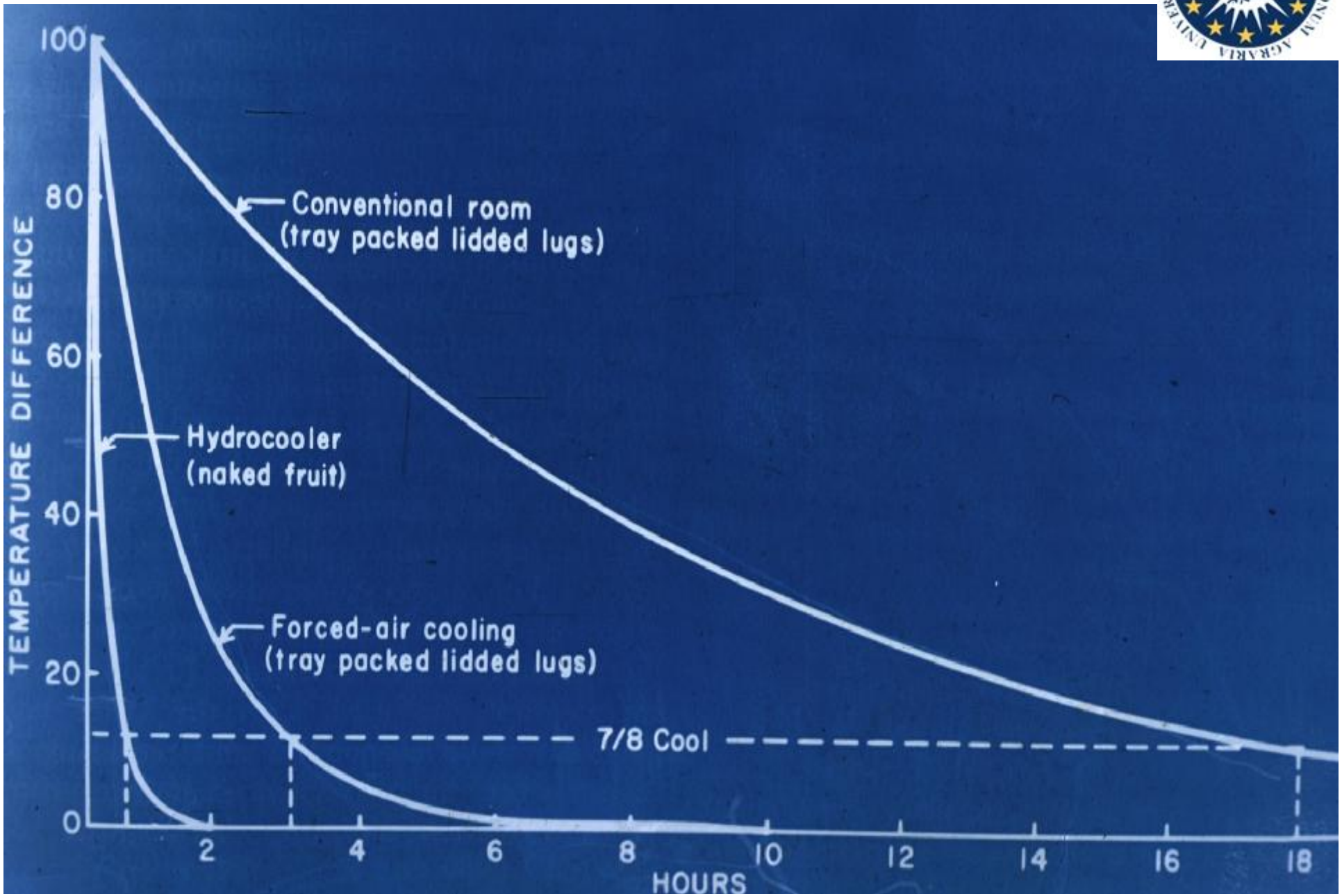
Container-venting



Designed vents

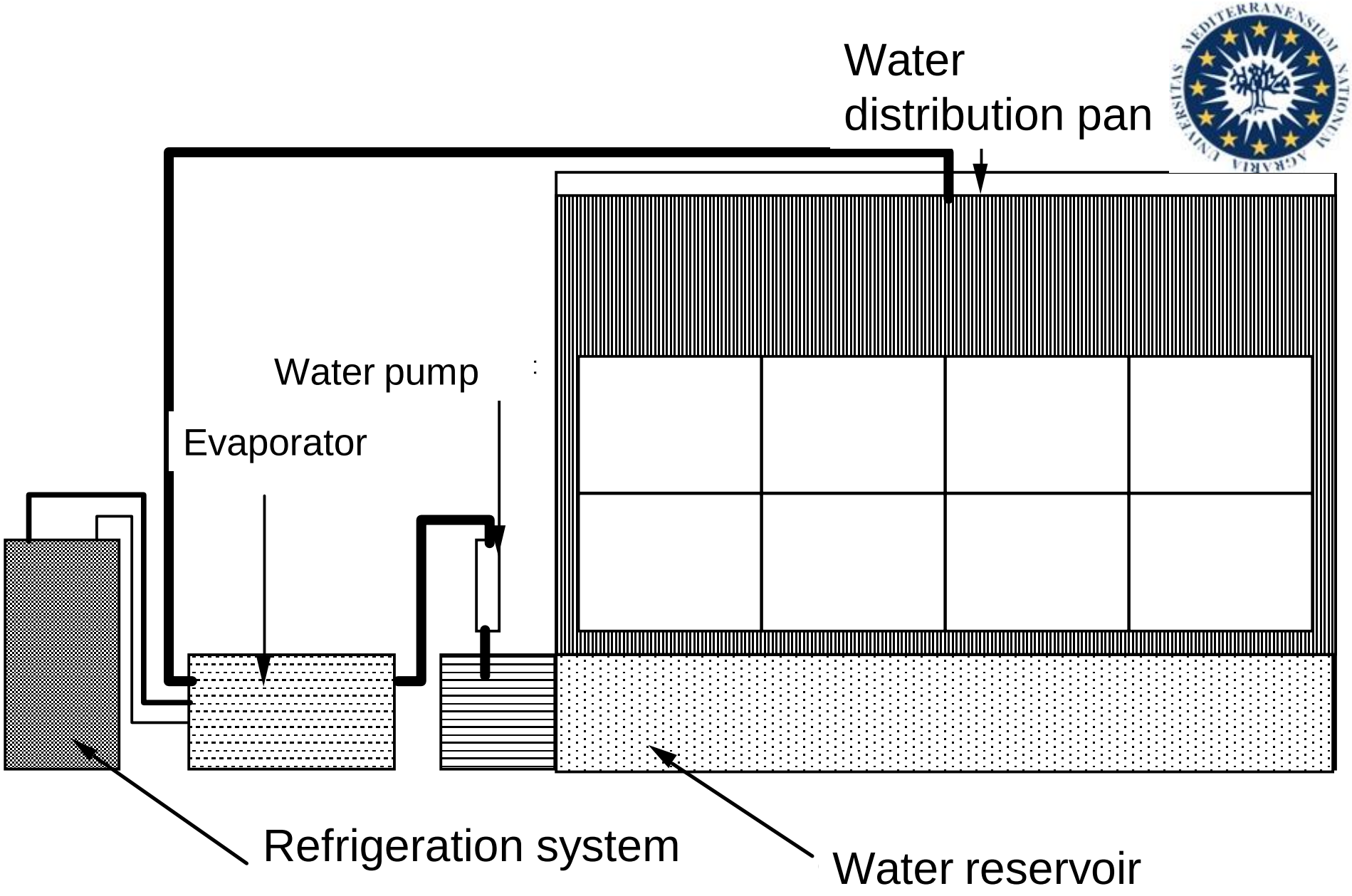


Half cooling time

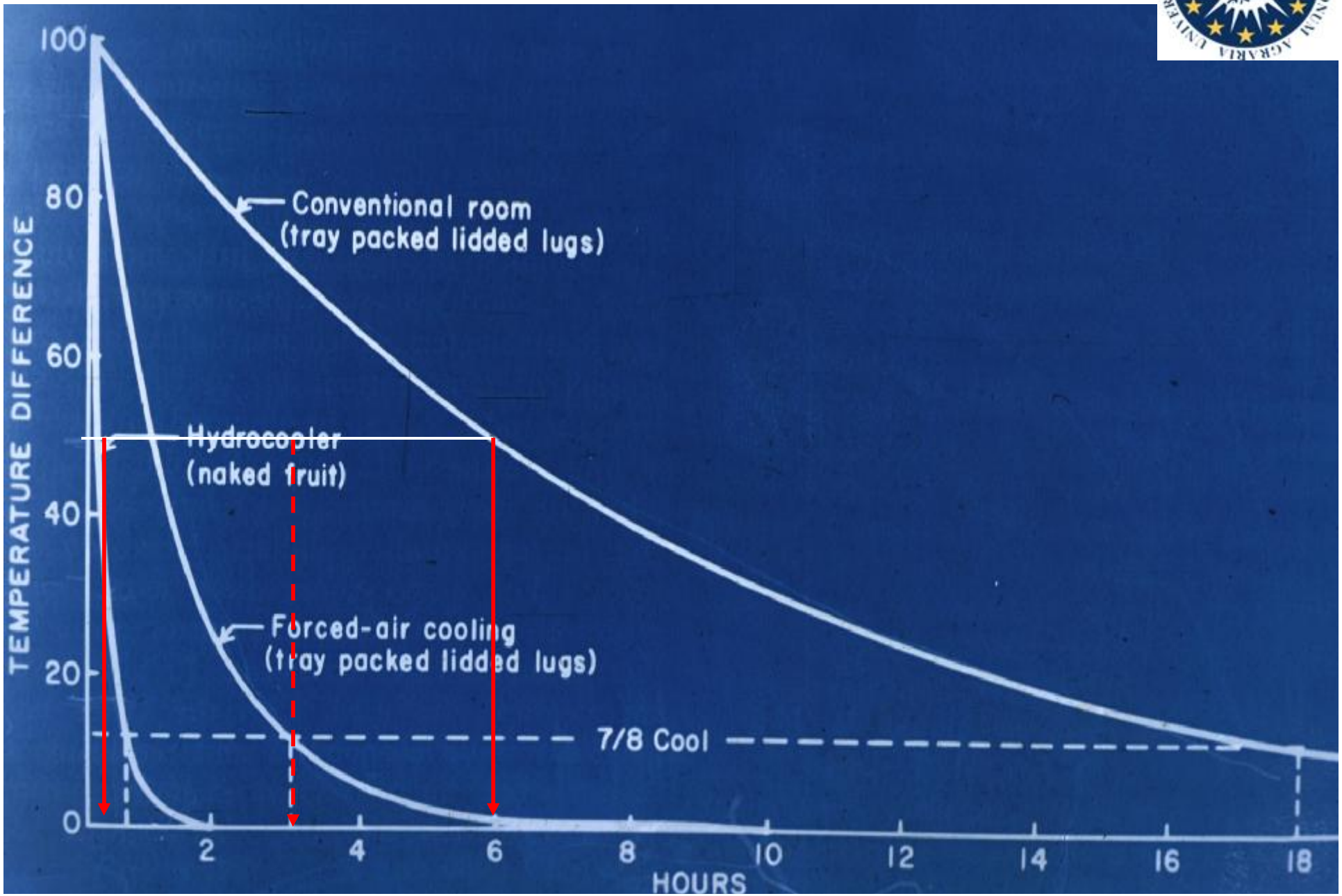


C. Hydrocooling

C.Hydrocooling


Water
distribution pan
Water pump
Evaporator
Refrigeration system
Water reservoir

Half cooling time



E. Hydrocooling

Increase cooling rate by:

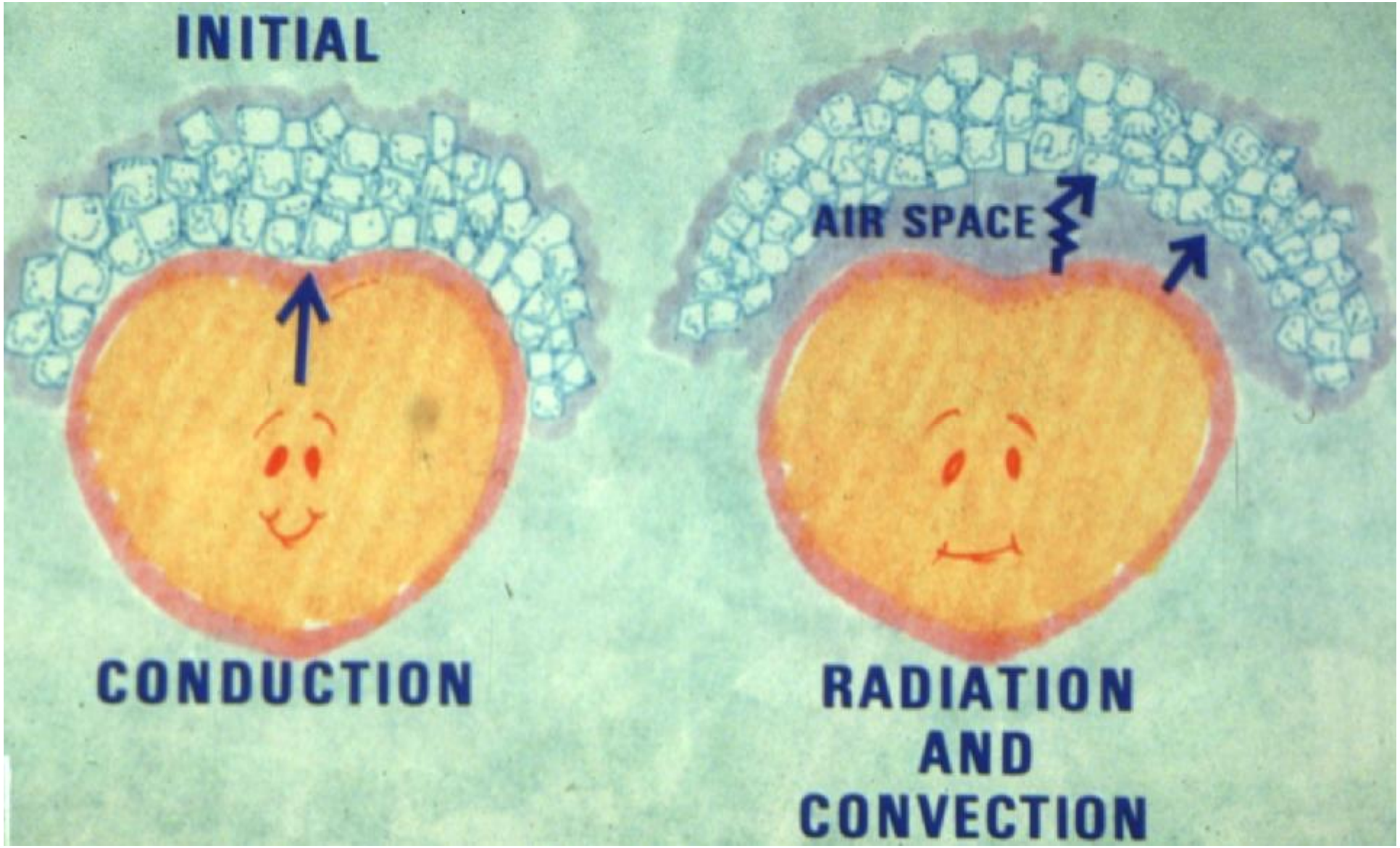
- Reduce water temperature
- Increase water circulation
- Increase product exposure

1. Cooling of horticultural commodities

COOLING METHODS

D. Package-icing

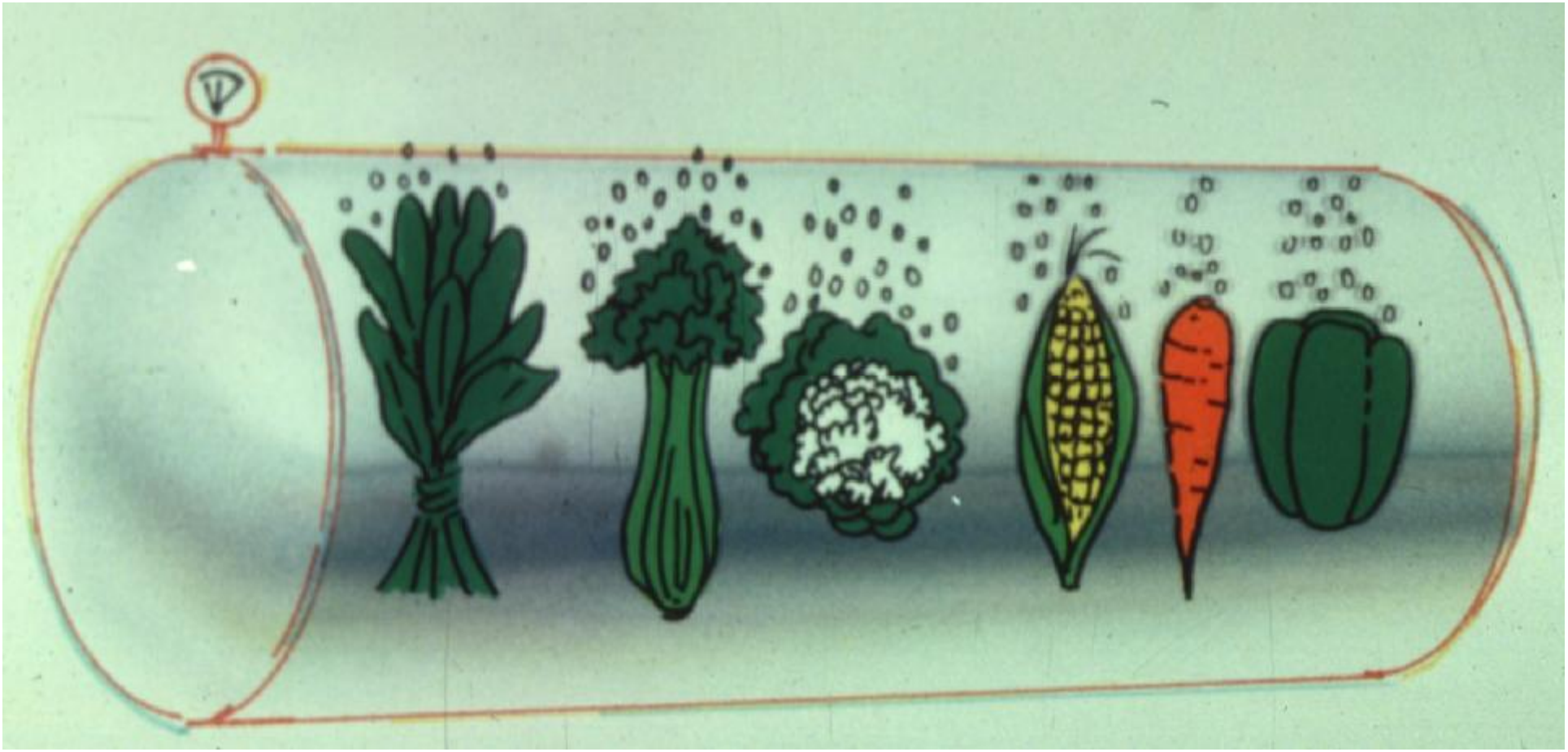
Package-icing



Package icing

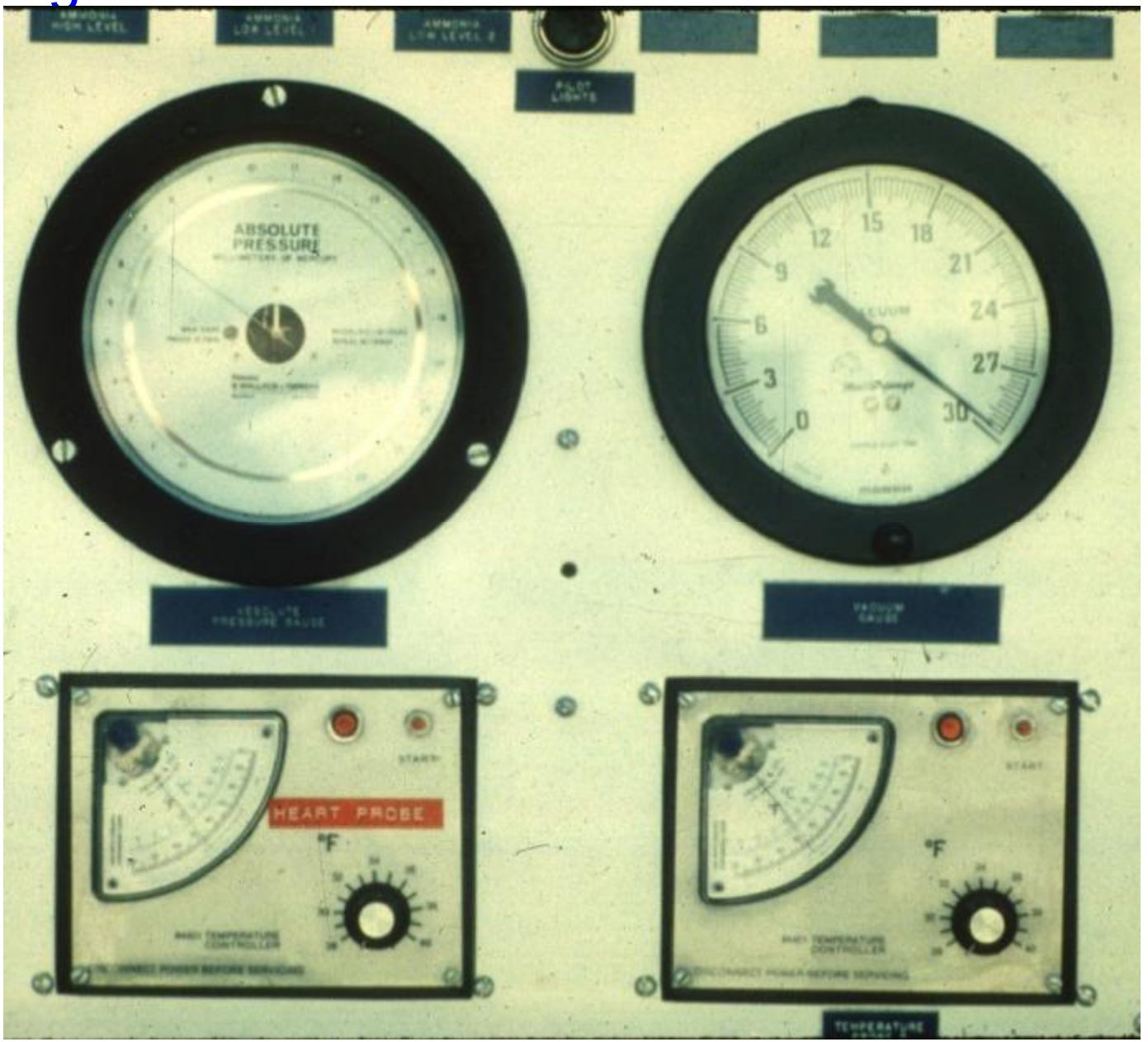
60% ice
40% water

E. Vacuum cooling

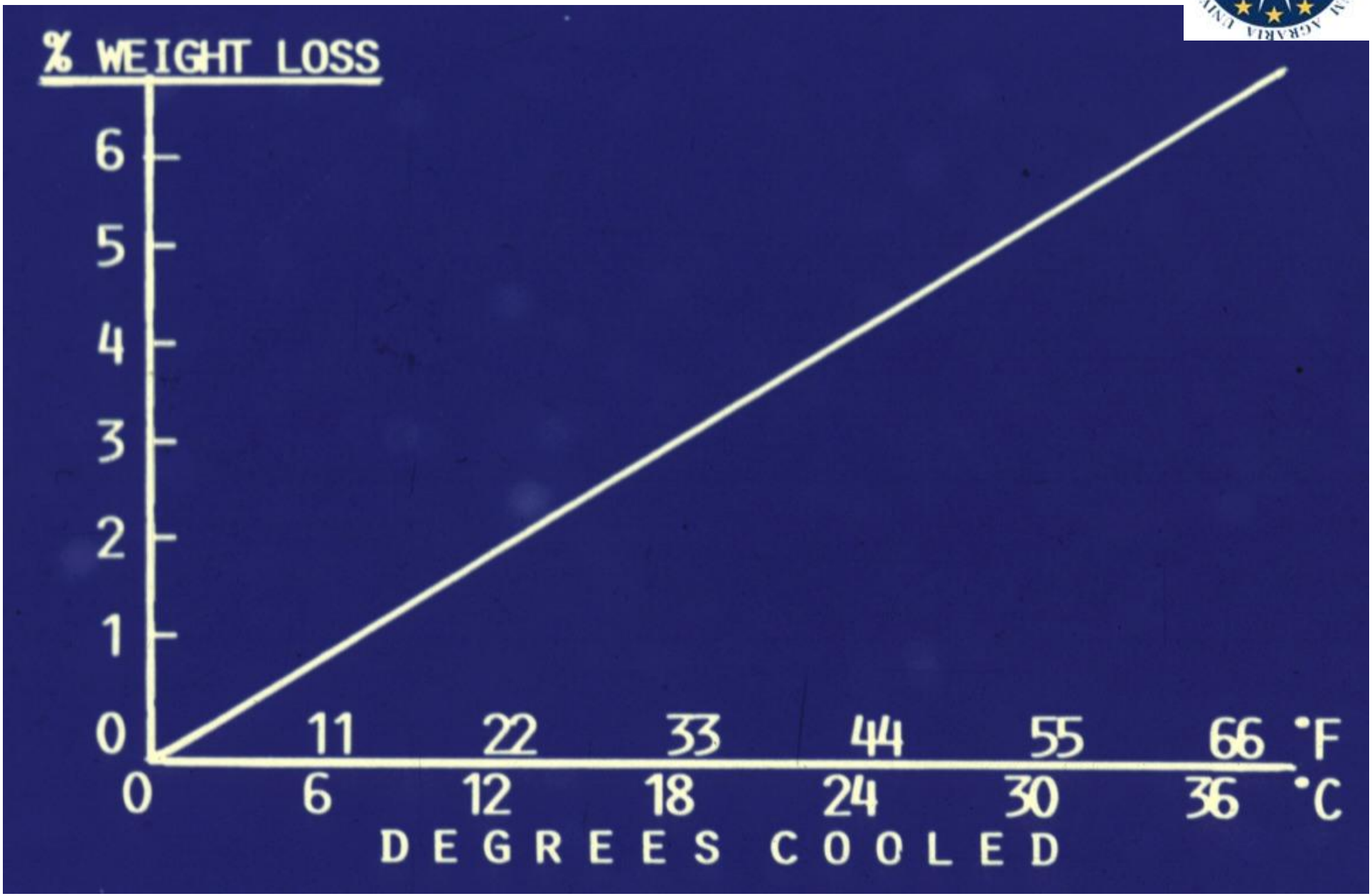


For leafy vegetables, celery, cauliflower,
and to a limited extend sweet corn, carrots and peppers

Monitoring product temperature to prevent freezing



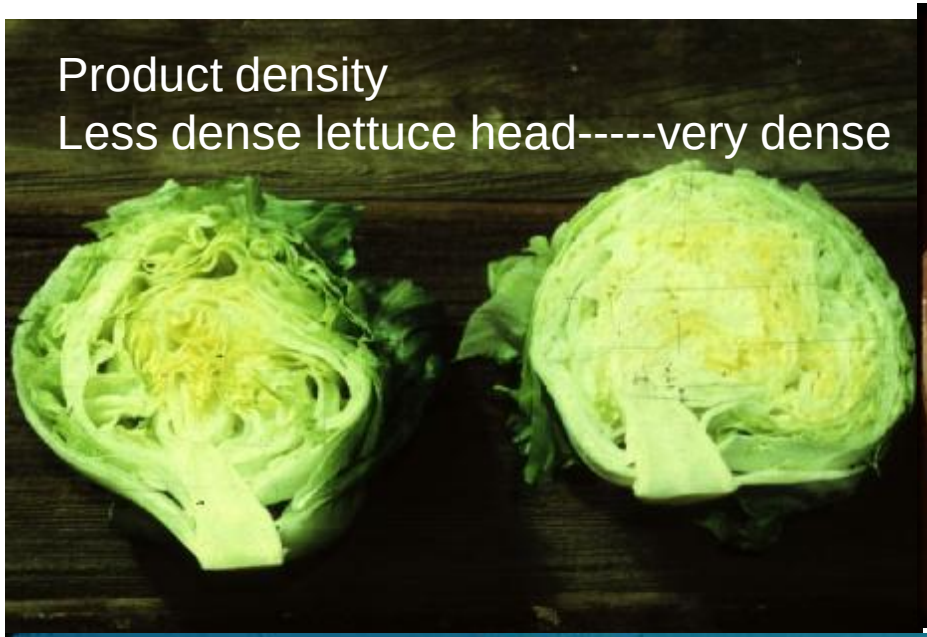
1% weight loss/6°C drop



Vacuum cooling

To prevent water loss by providing a water shower

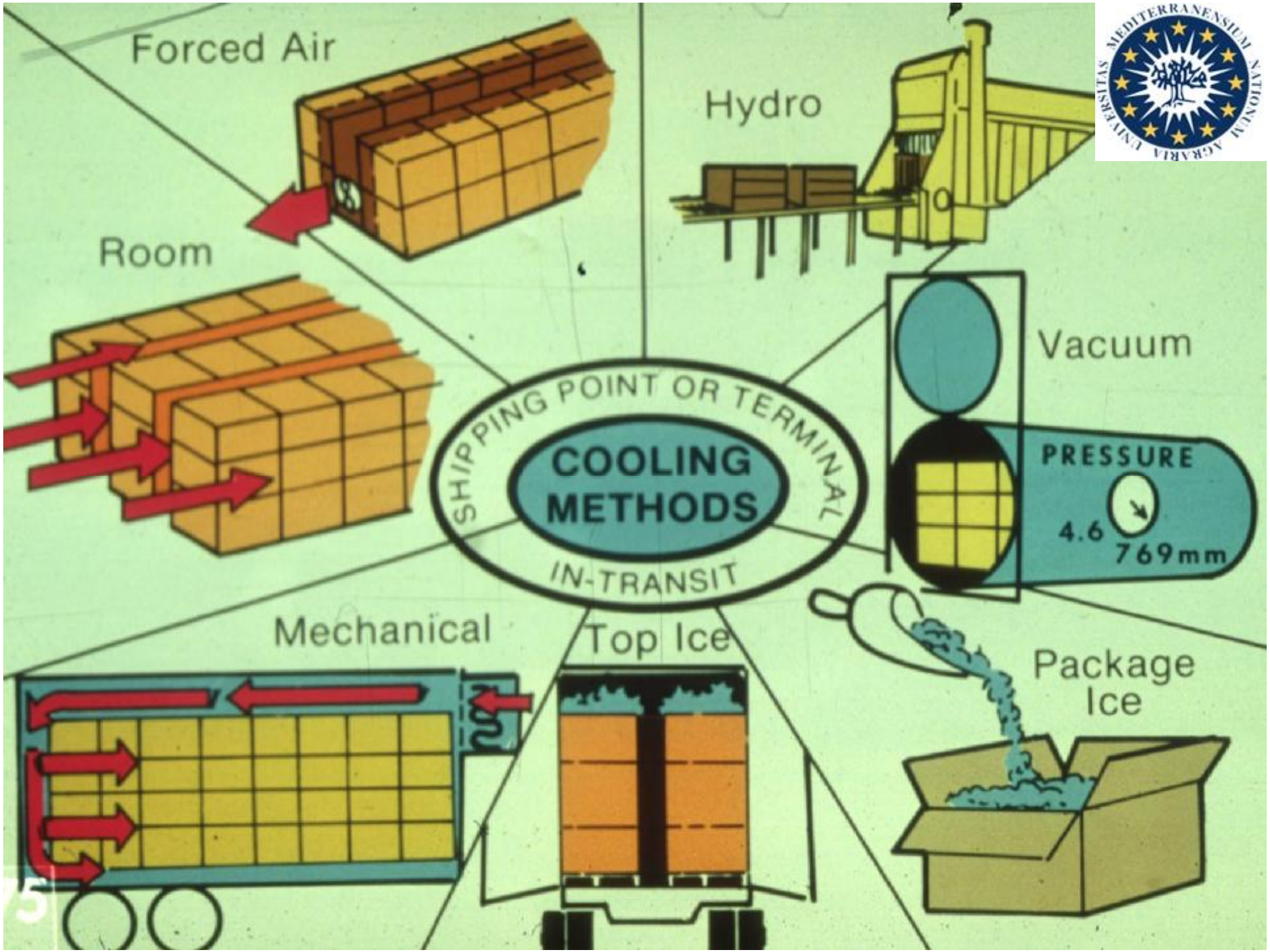
Other factors affecting precooling



Package materials

You can help by:

1. Harvesting in the coolest part of the day
2. Keeping delays between harvesting and cooling as short as possible
3. Parking loaded field vehicles in the shade while waiting for unloading


Forced Air
Hydro
Room
Vacuum
SHIPPING POINT OR TERMINAL
COOLING METHODS
IN-TRANSIT
PRESSURE
4.6
769mm
Mechanical
Top Ice
Package Ice